

Presentation to the 49th JANNAF Propulsion Meeting

Propulsion Research Center
Space Transportation Directorate
Marshall Space Flight Center, AL

Paving a Highway to Space

"We cannot foresee the ingenuity that companies, established or entrepreneurial, will bring to the building of new industries in the 21st century based upon the Highway to Space"

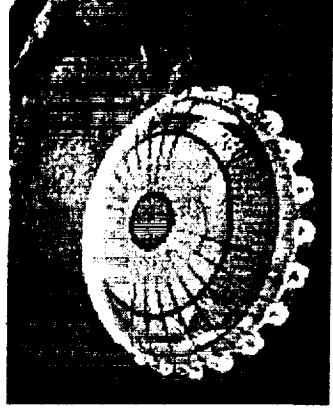
Interstellar Propulsion
Research

In-Space Focus

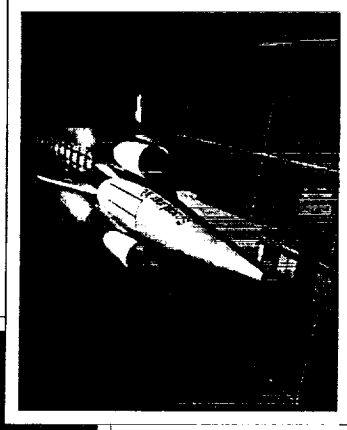
RLV Focus

Small Payload Focus

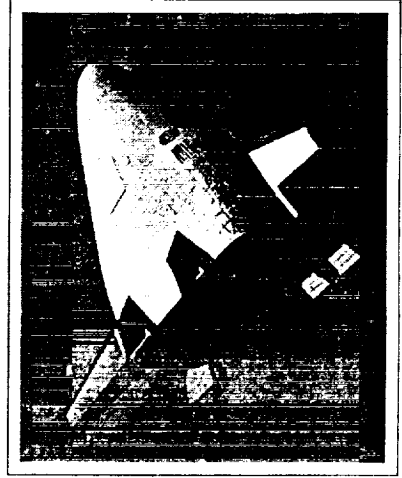
Earth-To-Orbit



Long-Term



Mid-Term



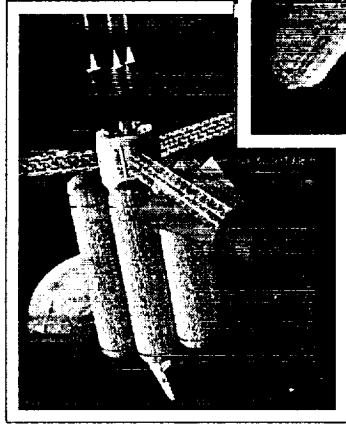
Near-Term



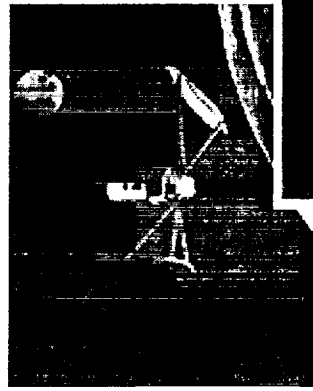
Orbit and Beyond



Interstellar



Planetary

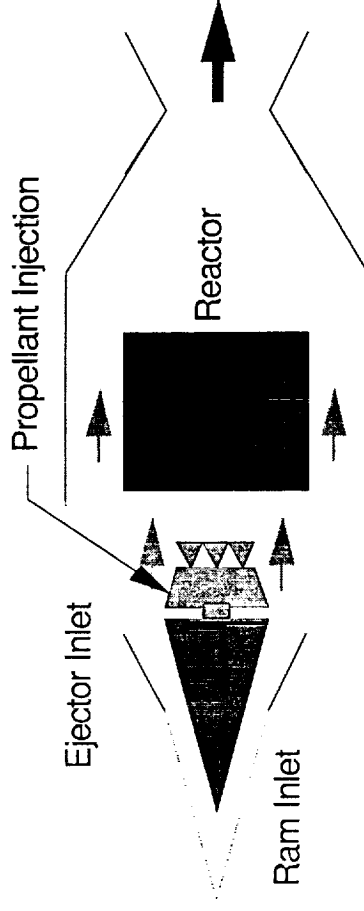
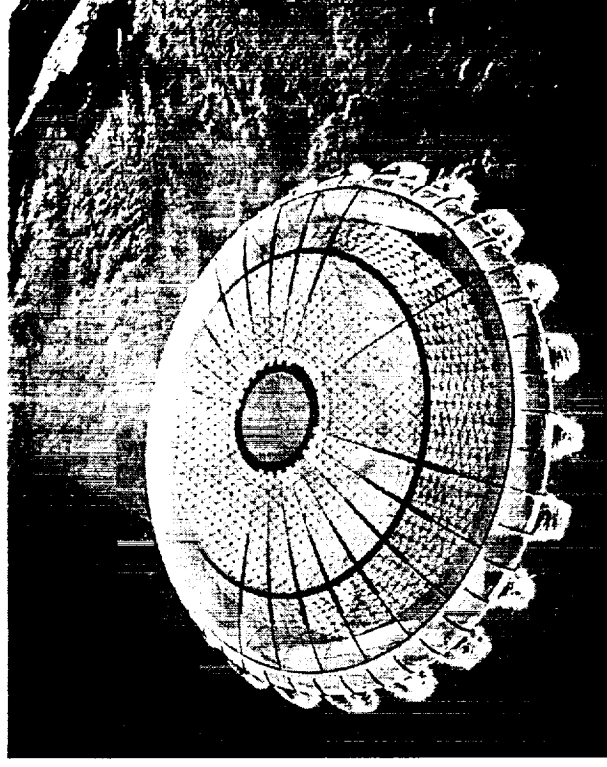


Orbital



Duct Propulsion

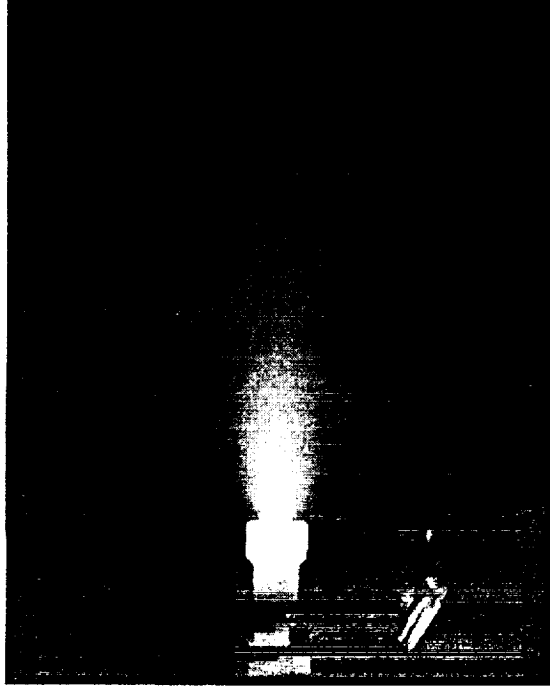
Rocket-based combined cycle



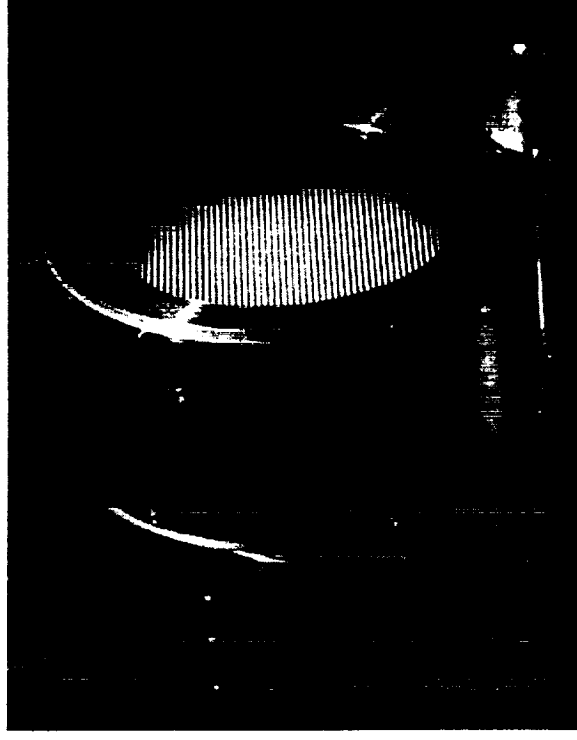
Microwave/MHD launch
concept

Nuclear-based combined cycle
(Ejector-ramrocket)

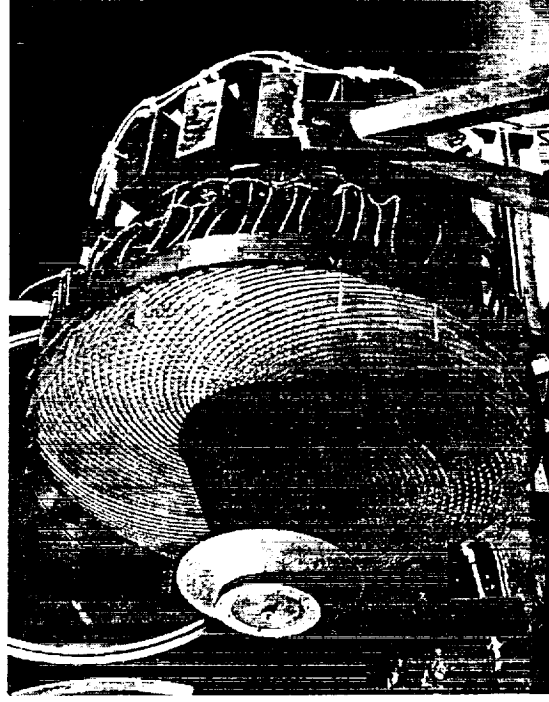
Electric Propulsion



Hydrazine arcjet



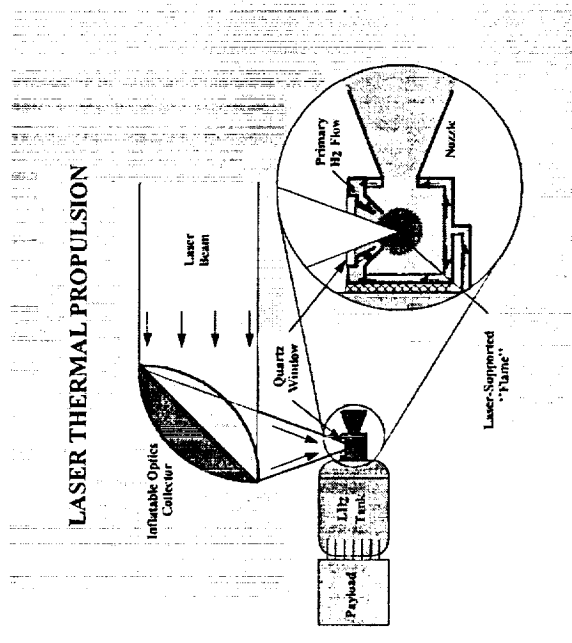
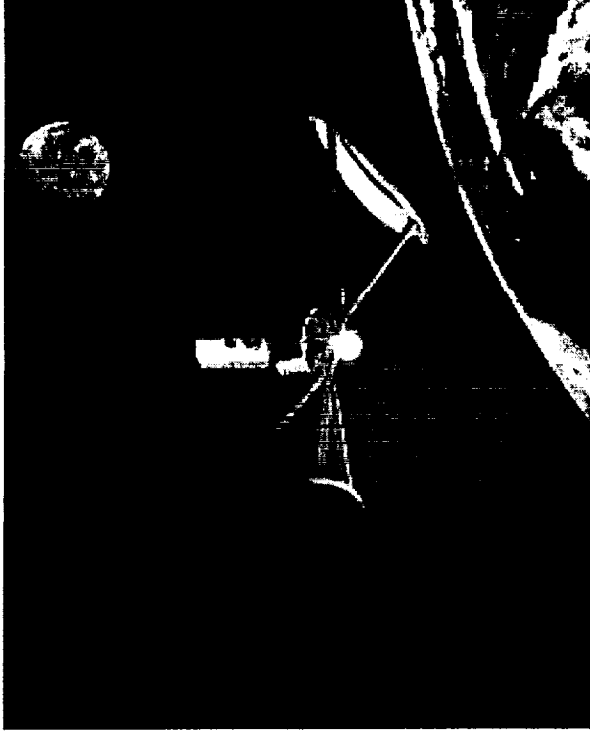
Ion thruster



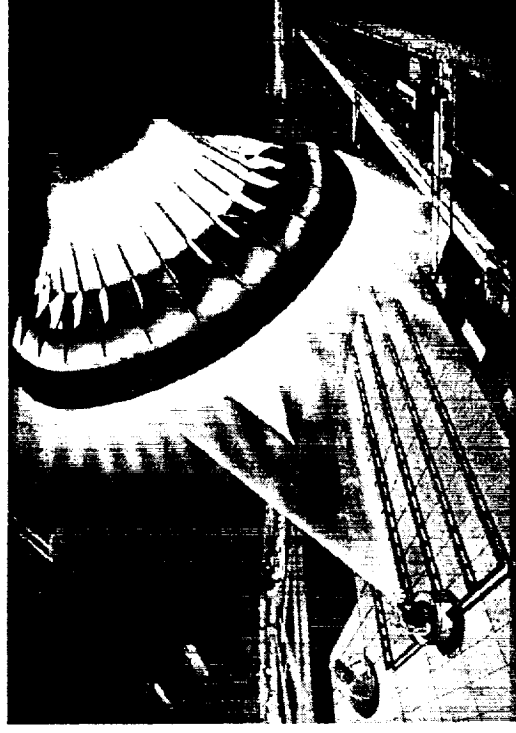
Pulsed inductive thruster

Beamed Energy Propulsion

Solar thermal upper stage



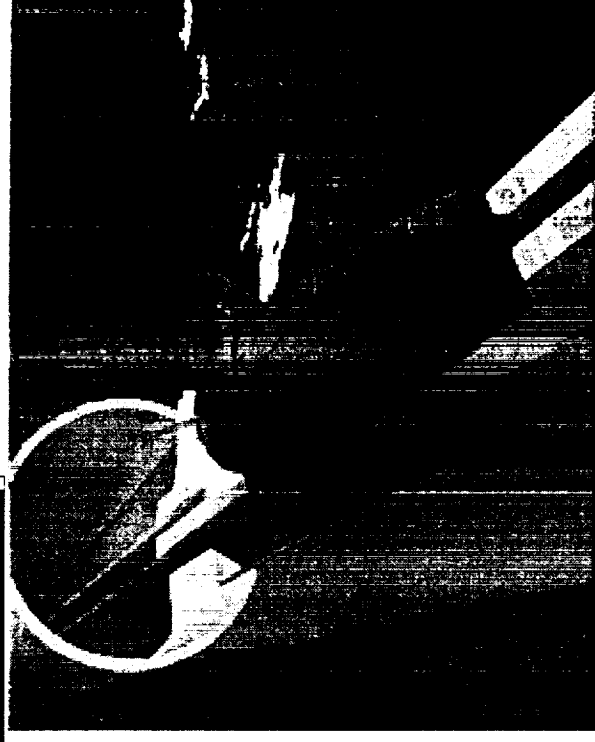
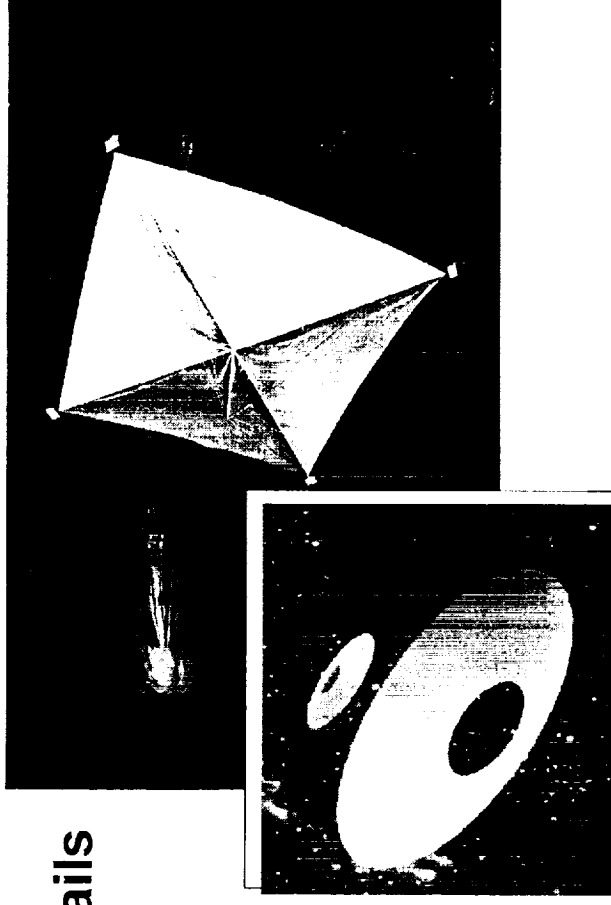
Continuous laser thermal
rocket



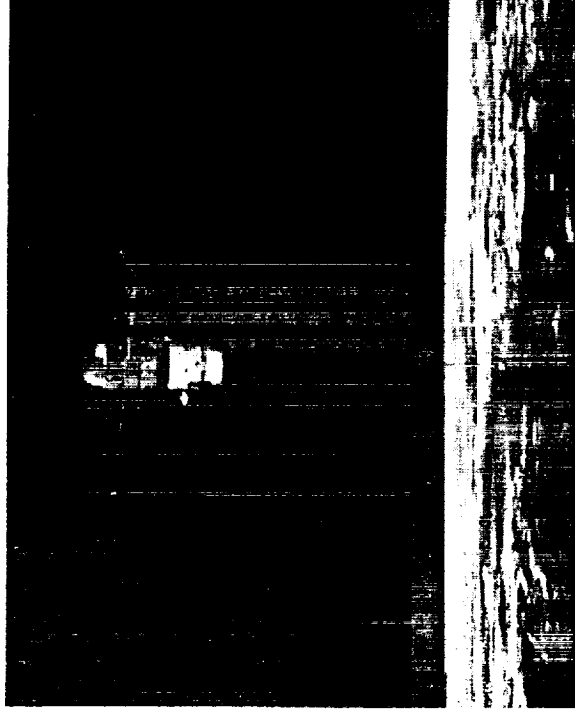
Lightcraft laser pulsejet

Externally-Effectuated Force

Solar & laser -propelled sails

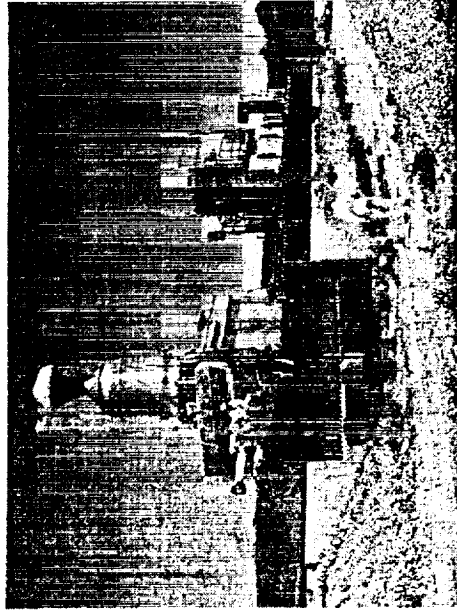


Electrodynamic tether

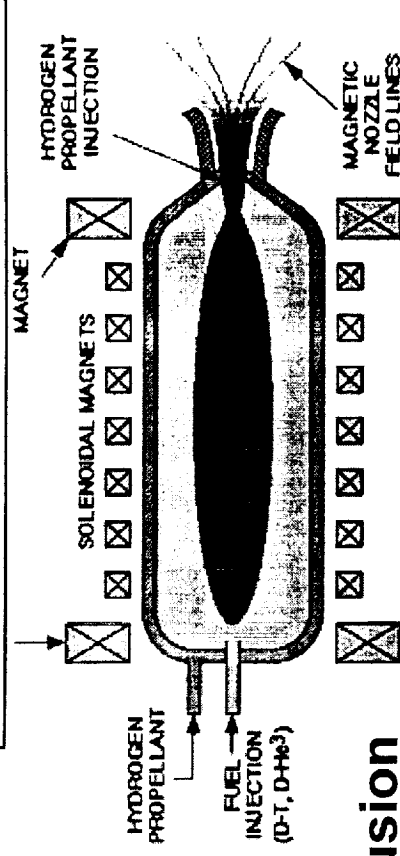


Magnetic sled launch assist

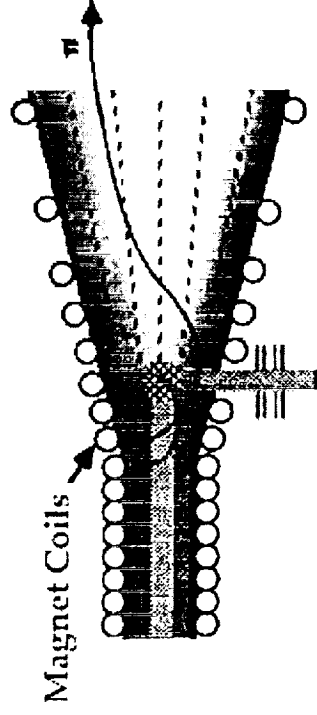
Nuclear Propulsion



NERVA solid core nuclear thermal rocket



Gasdynamic mirror fusion

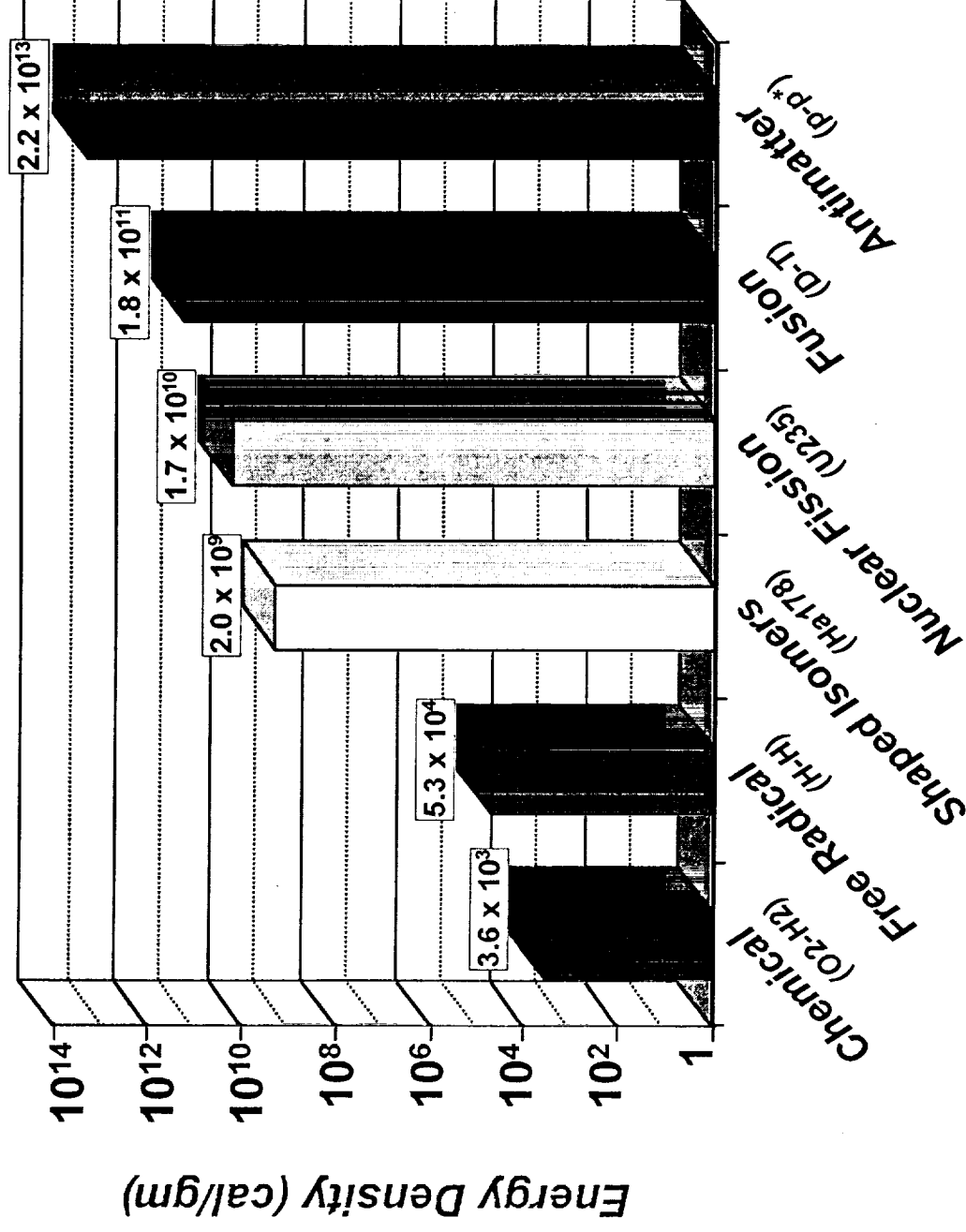


Beamed core matter-antimatter rocket

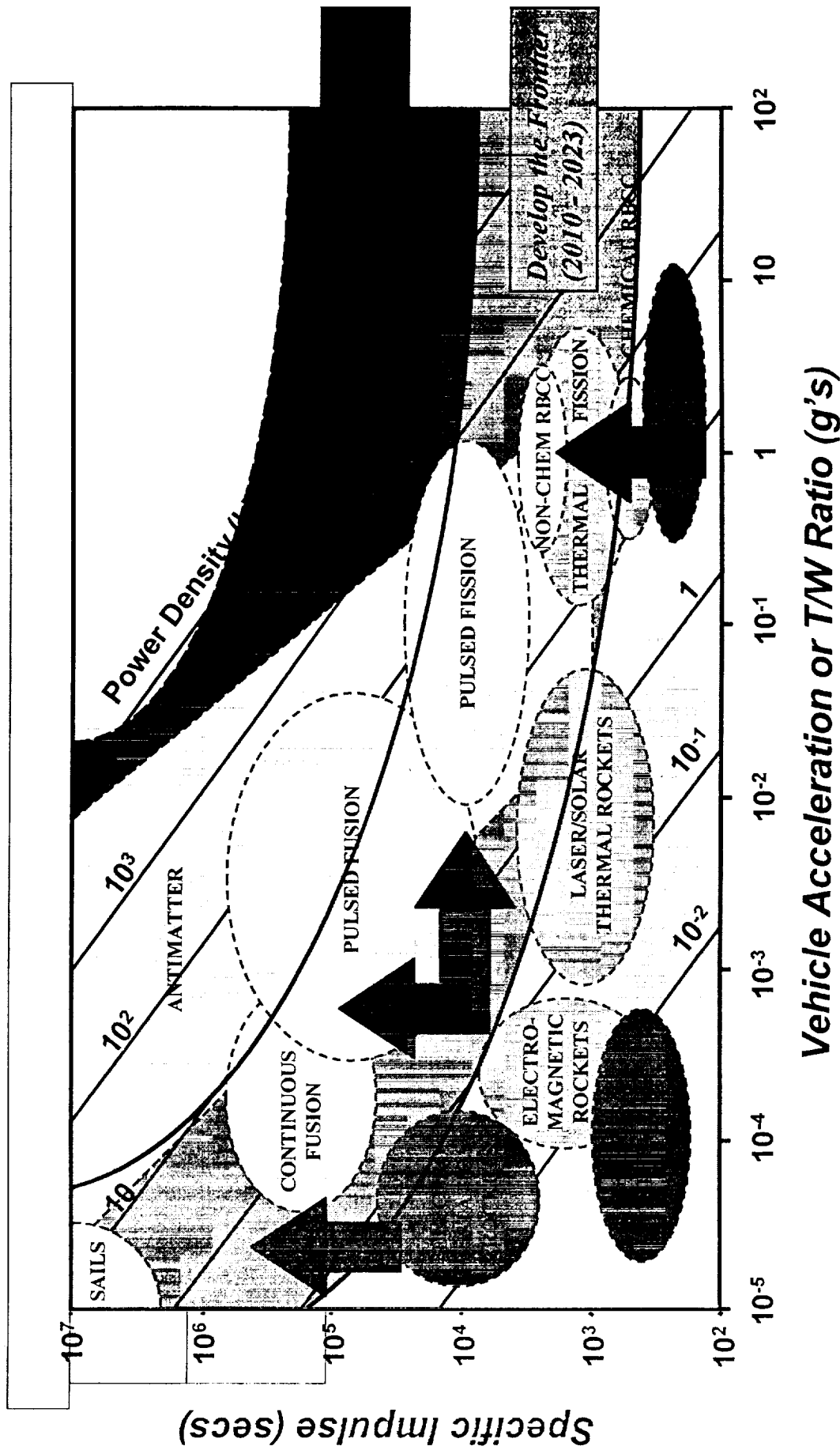
Nuclear Pulse Propulsion

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The road to higher power densities & performance

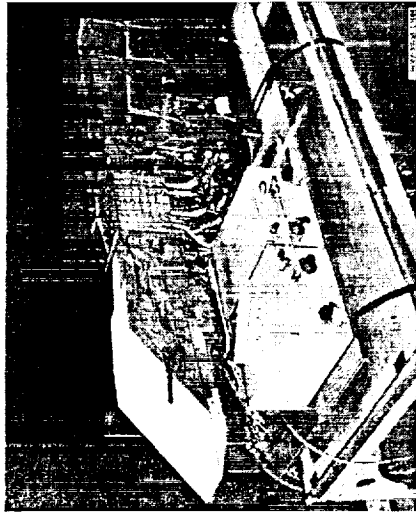


Propulsion technology map



- Unproven Technology (TRL 1-3)
- Demonstrated Technology (TRL 4-6)
- Operational Systems (TRL 7-9)

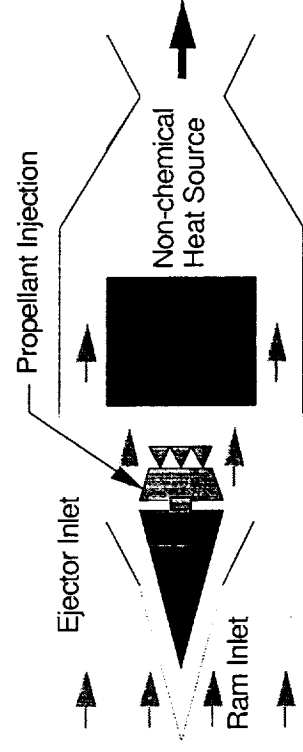
Launch Applications



RBCC engine flowpath test article at GASL

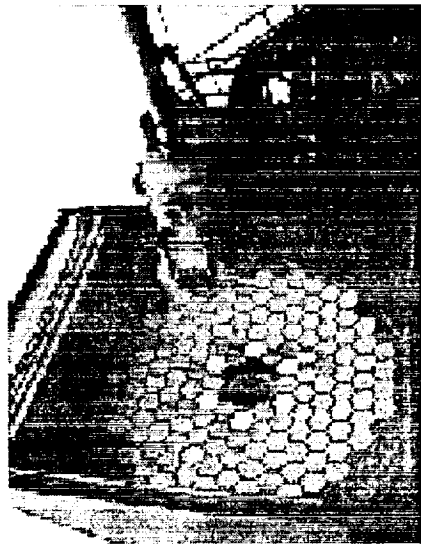
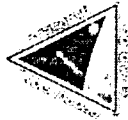


Laser Lightcraft indoor flight test



Non-chemical Ejector Ram-rocket

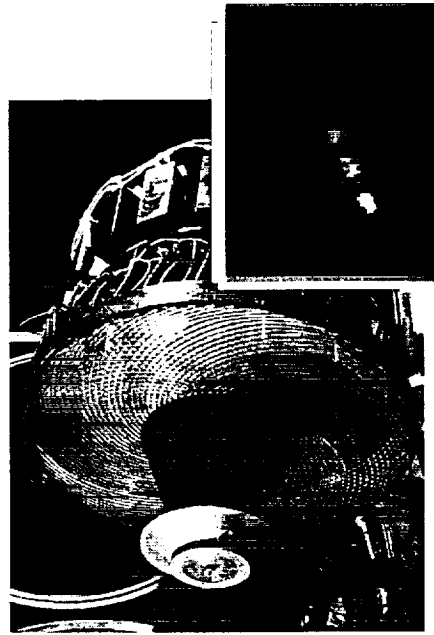
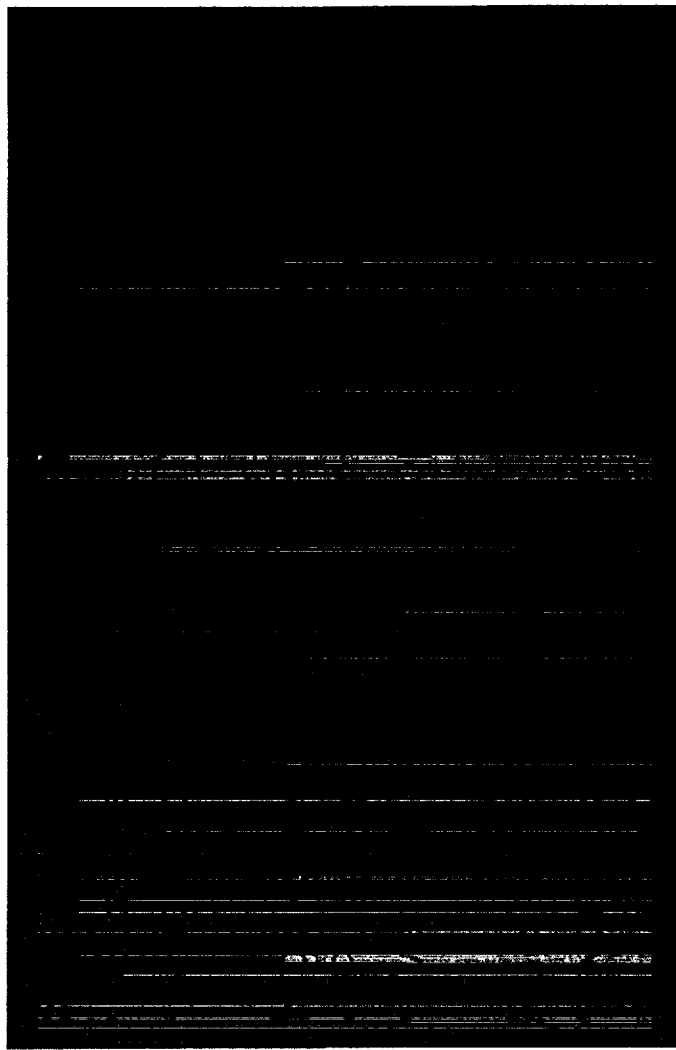
Space Applications



MSFC Solar Thermal Test Facility concentrator

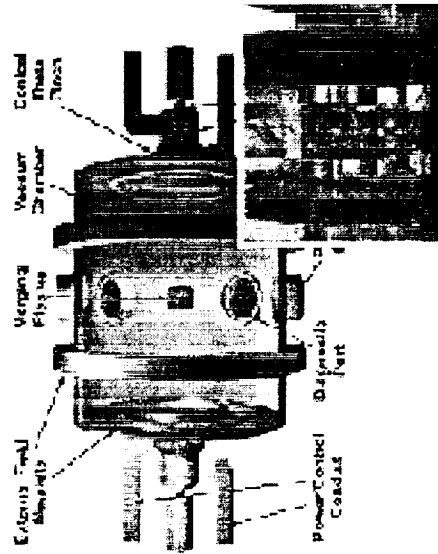
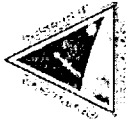


MSFC bimodal nuclear heat pipe reactor test

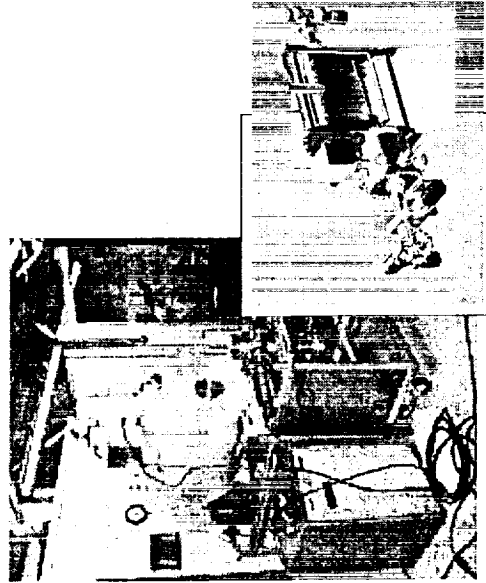


TRW & MSFC pulsed inductive thrusters

Advanced High-Energy Concepts



MTF plasma target generator



High-Performance Antimatter Trap (HiPAT)

Advanced Nuclear Applications

- Alternative nuclear processes
- Nuclear pulse propulsion assessment

Fusion

- Magnetized Target Fusion (MTF)
- Gasdynamic mirror
- Inertial Electrostatic Confinement (IEC)

Antimatter

- High-performance antiproton trap (HiPAT)
- Plasma gun/thruster demo